

University of Dundee

Images of Microbiology

Bergkessel, Megan; Cameron, Amy; Coulthurst, Sarah; De Rycker, Manu; Dorfmueller, Helge; Hardee, Erin

DOI:

[10.20933/100001214](https://doi.org/10.20933/100001214)

Publication date:

2021

Document Version

Publisher's PDF, also known as Version of record

[Link to publication in Discovery Research Portal](#)

Citation for published version (APA):

Bergkessel, M., Cameron, A., Coulthurst, S., De Rycker, M., Dorfmueller, H., Hardee, E., Houghton, L., Floyd, A., Fomina, M., Gadd, G. M., Hsu, C-Y., Kalamara, M., Kang, X., Mackintosh, A., Mansoor, S., Manthri, S., Rosazza, T., Stephenson, K., Thomas, J., ... Stanley-Wall, N. (2021, May). Images of Microbiology. University of Dundee. <https://doi.org/10.20933/100001214>

General rights

Copyright and moral rights for the publications made accessible in Discovery Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from Discovery Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain.
- You may freely distribute the URL identifying the publication in the public portal.

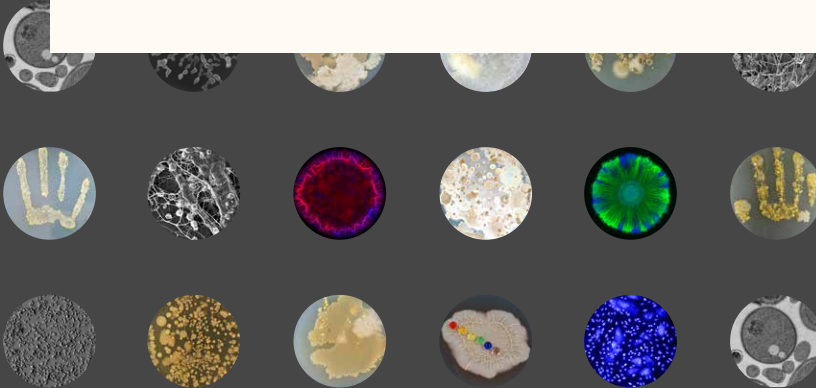
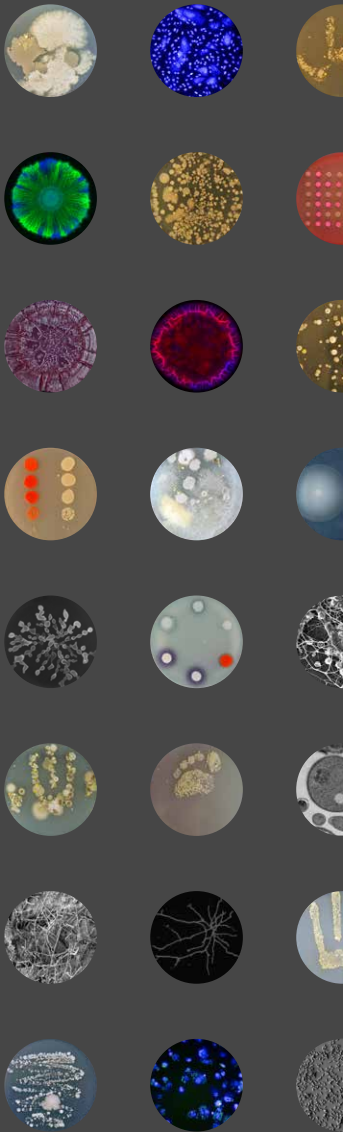
Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



School of Life Sciences
University of Dundee

Images of microbiology



CONTENTS

2	INTRODUCTION	17	SEARCHING FOR FOOD
3	SKIN MICROBES	18	BIOFILM BUILDING
4	GROWING BACTERIA	19	SOIL MICROBES
5	LIVING TOGETHER	20	BACTERIAL REACTIONS
6	ANTIBIOTIC RESISTANCE	21	MICROBE CARE
7	MICROBES COMPETING	22	SKIN MICROBES
8	COLOURED BACTERIA	23	BACTERIAL COLONIES
9	MICROBE COMMUNITIES	24	BACTERIAL STRUCTURES
10	LEISHMANIASIS	25	FOOD POISONING
11	MAKING MINERALS	26	MICROBE CONDITIONS
12	MOVING BACTERIA	27	MICROBE JOBS
13	ANTIBIOTICS FROM SOIL	28	MICROBE HOMES
14	FUNGAL COLONY	29	PROTEIN SPEARGUNS
15	WATERPROOF BACTERIA	30	HIDING INSIDE
16	FUNGUS AT WORK	31	ABOUT THE SCIENTISTS

Note: The information about scale refers to the images at Dundee Science Centre, which are 15cm in diameter.

INTRODUCTION

Microorganisms (microbes for short) come in a dazzling array of shapes and (small) sizes. Microbes include archaea, bacteria, fungi, viruses, and protists. They can be found living in most places on Earth, including deep sea vents, volcanic soil, on and inside plant roots, stems and leaves, and in your intestines.

The look and properties of a microbe are determined by its DNA, a set of instructions that dictates how an organism will grow, reproduce, and move. People have harnessed microbes to make many helpful things. We use them to produce tasty foods like bread, yogurt, and chocolate, as well as components used essential household items including toothpaste and laundry detergent. Some of the medicines we are prescribed by doctors are made by microbes, for example penicillin.

Many microbes help us and live in our mouths, nose, gut, and on our skin. In fact, there are more microbes living on and in your body than there are in stars in the night sky. Our microbes help to keep our immune system strong and make vitamins to help us grow.

Some microbes can infect our body, making us sick. Antimicrobial medicines, such as antibiotics, are amazing tools for treating many different infections. But, over time, microbes can develop ways to grow in the presence of the medicines – this is called resistance. It means the medicine will not treat the infection.

Resistance can happen naturally as microbes reproduce very quickly, changing their DNA to allow them to grow in the presence of the medicine. Widespread use of antimicrobials in agriculture has allowed more chances for microbes to develop resistance in the environment. Scientists at the University of Dundee study this and other microbe-related topics to benefit human health, increase food production, resolve environmental problems, and improve lives all over the world.

Here you will find a series of images taken by scientists based at the University of Dundee that highlight the microbes they work with. The images in this collection are part of a physical exhibition located at the Dundee Science Centre.

Many thanks go to Amy Cameron, Erin Hardee, Ali Floyd, Ailsa Mackintosh, and the contributing scientists for valuable comments, writing contributions, and overall help during the preparation of both the materials for the physical exhibition and this document.

I hope you enjoy exploring the wonderful world of microbiology.

Nicola Stanley-Wall
Professor of Microbiology
School of Life Sciences
University of Dundee



Image:
Erin Hardee
University of Dundee

SKIN MICROBES

- Mixed Sample
- No magnification

Skin is covered by many different microbes. When we touch a surface, they can be transferred, in this case to an agar plate. Scientists use agar plates to grow microbes in their labs, so they can study them and learn more about them.

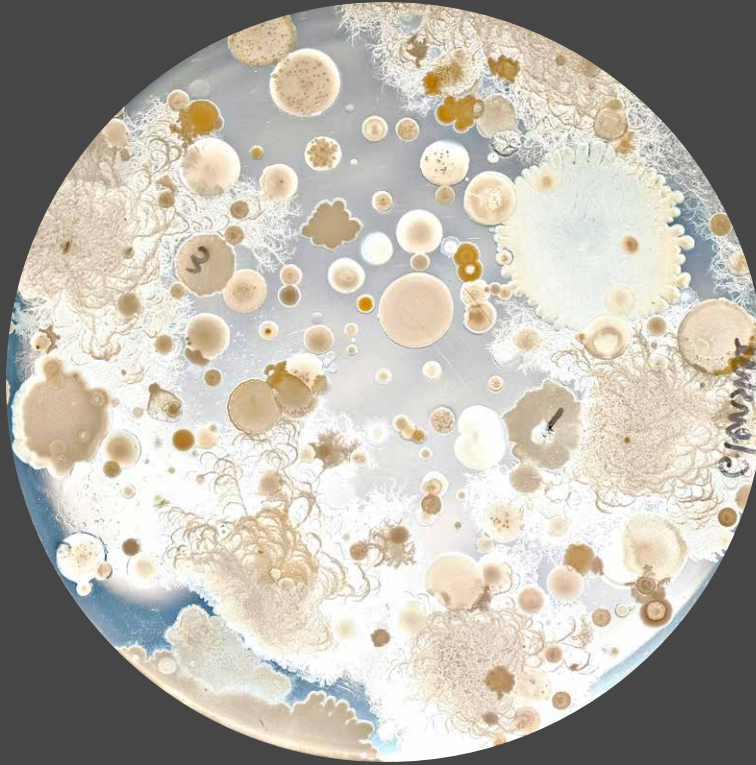


Image:
Nicola Stanley-Wall and Lewis Houghton
University of Dundee and lewspics.com

GROWING BACTERIA

- Mixed Sample
- Magnification 2x

Soil contains lots of different types of microbes. When these are placed on an agar plate and incubated (kept warm), the different microbes make more copies of themselves. Eventually they form colonies, which are groups of bacteria that are visible to the naked eye.

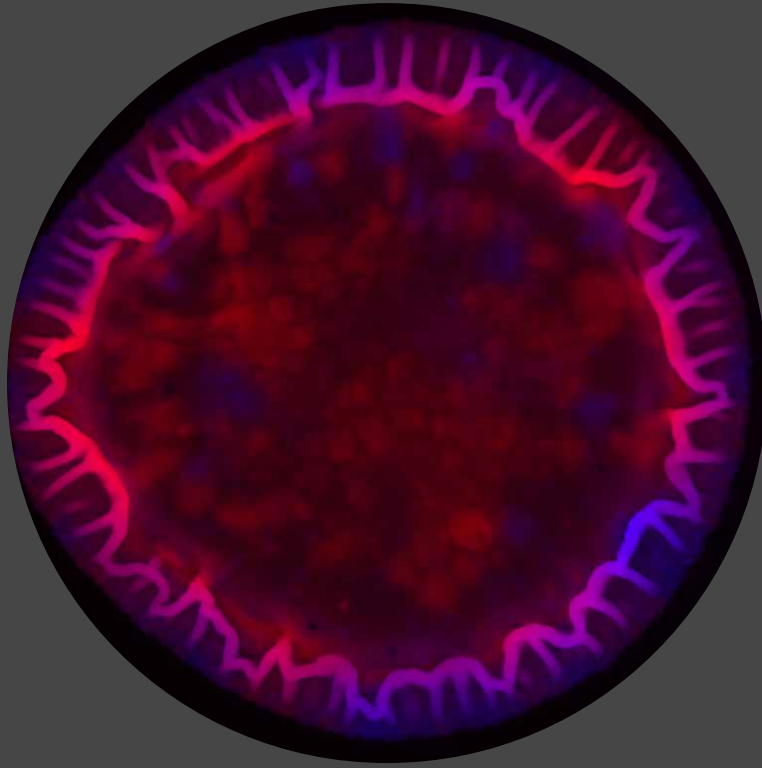


Image:
Margarita Kalamara
University of Dundee

LIVING TOGETHER

- Bacteria
- Magnification 5x

Bacillus subtilis lives in the soil and helps plants to grow. This is a biofilm that contains many billions of cells. The bacteria have been labelled either red or blue depending what type they are. You can see how closely the different bacteria live together.



Image:
Sarah Coulthurst
University of Dundee

ANTIBIOTIC RESISTANCE

- Bacteria
- Magnification 2x

These two strains of *Serratia marcescens* are being tested for antibiotic resistance. Scientists put different amounts of each bacteria on agar plates containing antibiotics to see if they can resist the antibiotic and grow - and these ones can!

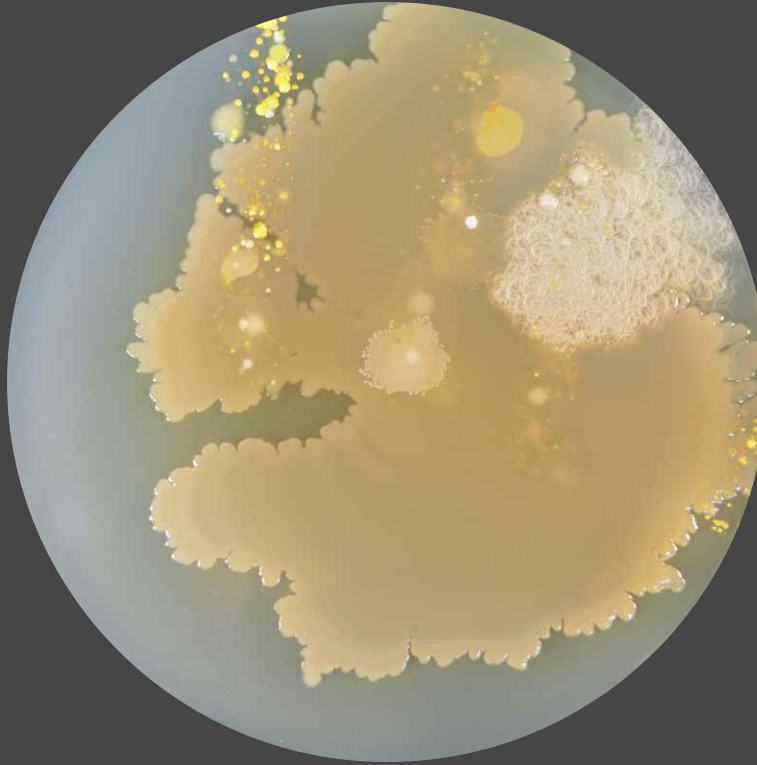


Image:
Margarita Kalamara
University of Dundee

MICROBES COMPETING

- Mixed Sample
- Magnification 2x

Soil contains many different types of microbes. The different species must fight for space, food, and vitamins, and each species uses different strategies to try and win the battle and grow the strongest.

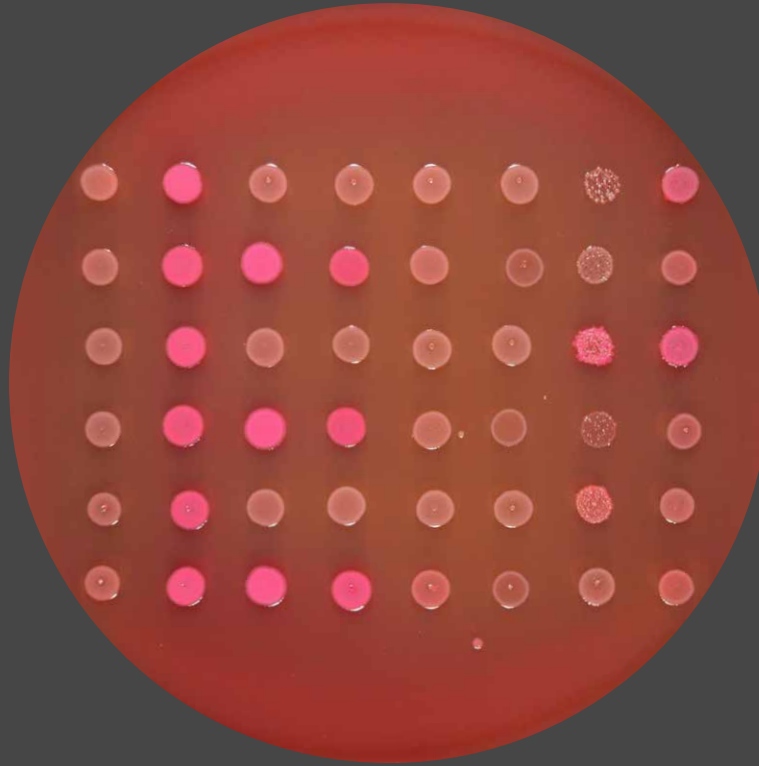


Image:
Saria Mansoor and Helge Dorfmueller
University of Dundee

COLOURED BACTERIA

- Bacteria
- No magnification

This is a range of *Escherichia coli* (*E. coli* for short) growing in colonies on an agar (jelly) plate. The colonies turn pink when the bacteria produce a substance that reacts with the agar they are growing on.



Image:
Erin Hardee
University of Dundee

MICROBE COMMUNITIES

- Mixed Sample
- No magnification

Having a microbiome (community of microbes) living in and on us is an integral part of being human. Did you know that *Escherichia coli* lives in our gut and provides many necessary vitamins including Vitamin K and B-complex vitamins?

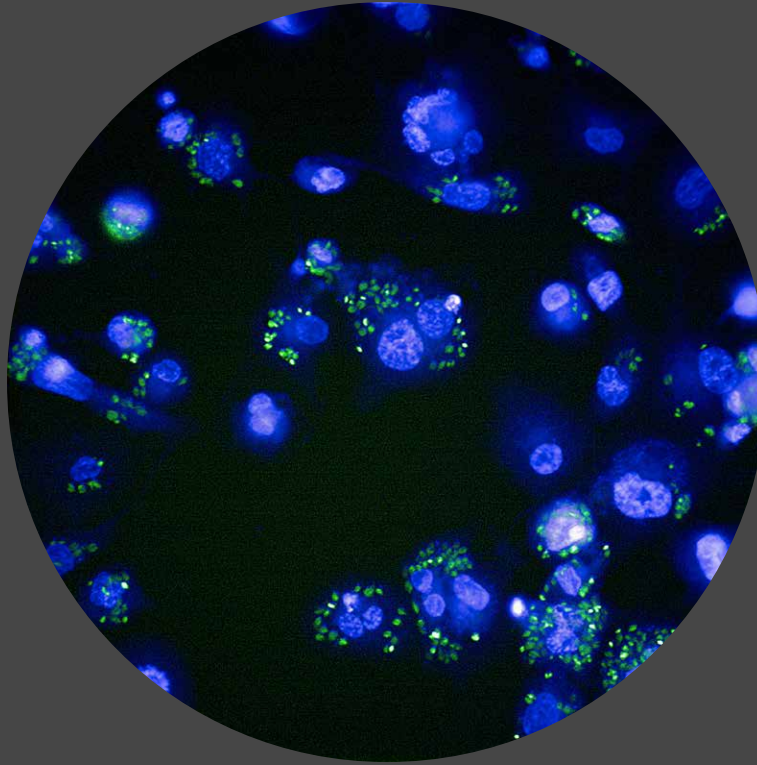


Image:
Manu De Rycker and Sujatha Manthri
University of Dundee

LEISHMANIASIS

- Protozoa
- Magnification 2000x

Here we see human cells, with their DNA stained blue, and the deadly parasite *Leishmania donovani* glowing green inside them. The disease leishmaniasis is caused by these parasites and kills thousands each year.

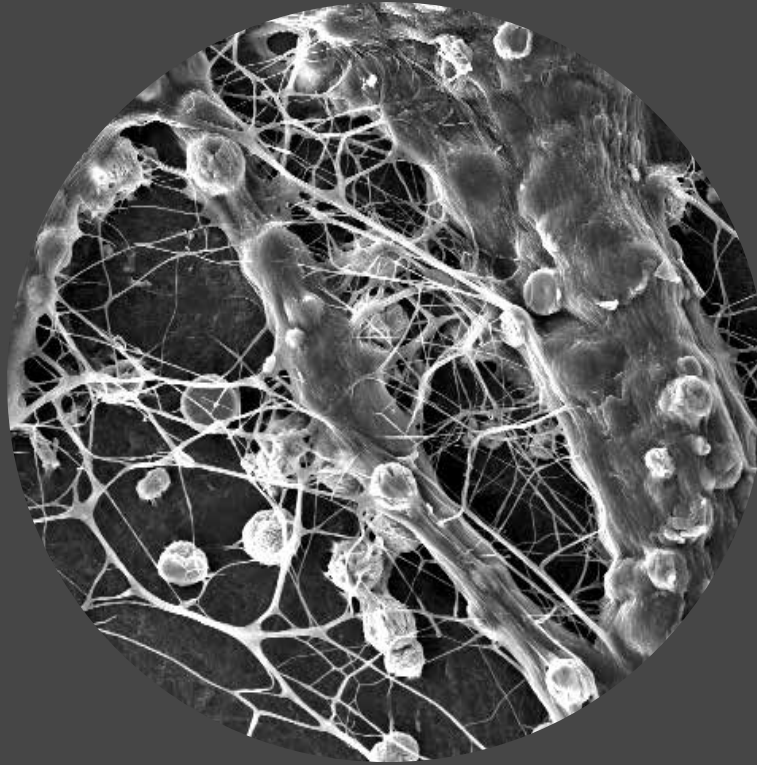


Image:
Marina Fomina and Geoff Gadd
University of Dundee

MAKING MINERALS

- Fungus
- Magnification 320x

Beauveria caledonica can make new minerals. The thin threads (hyphae) are the growing and branching 'body' of the fungus. Sometimes these threads grow together and make thicker strands covered with a jelly-like coating. The spheres are crystals of a copper mineral that the fungus has made.

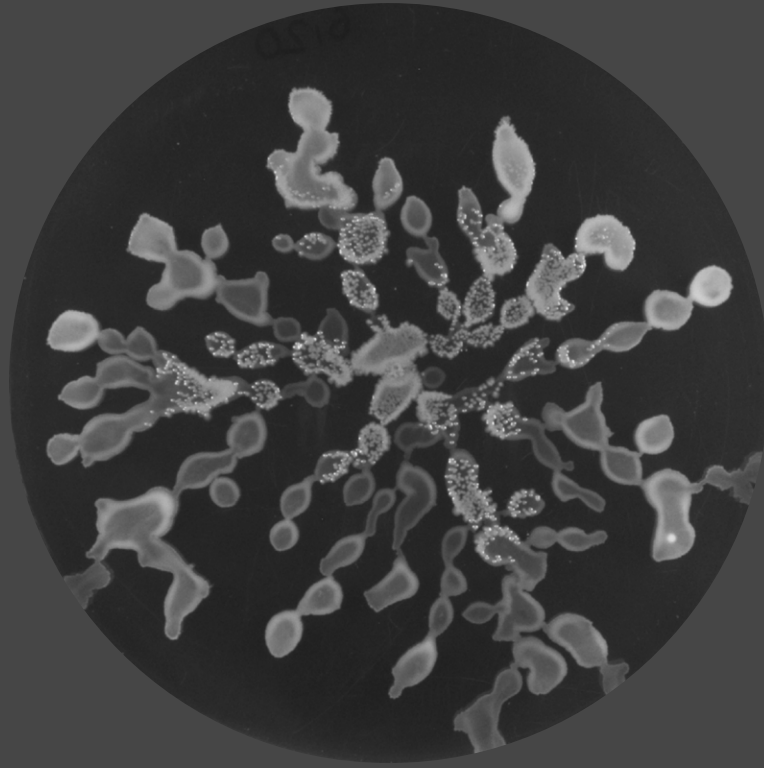


Image:
Margarita Kalamara
University of Dundee

MOVING BACTERIA

- Bacteria
- Magnification 2x

These *Bacillus subtilis* bacteria began in the middle of this agar plate. Over time they used their flagella, which act like propellers, to move across the surface in search of more space to grow and food to eat.



Image:
Margarita Kalamara
University of Dundee

ANTIBIOTICS FROM SOIL

- Mixed Sample
- Magnification 2x

The word antibiotic was first used as a noun in 1941 to describe any small molecule made by a microbe that blocks the growth of other microbes. Many of the antibiotics that are used in healthcare are made by soil microbes, including penicillin and tetracycline.



Image:
Karen Stephenson and Geoff Gadd
University of Dundee

FUNGAL COLONY

- Fungus
- Magnification 280x

This is a fungus colony (*Neurospora crassa*) that has grown from a single spore. The fungus grows out from the spore making threads or filaments called hyphae which branch and explore the surface to find nutrients.



15



Image:
Nicola Stanley-Wall
University of Dundee

WATERPROOF BACTERIA

- Bacteria
- Magnification 5x

The biofilm formed by *Bacillus subtilis* is highly water repelling (hydrophobic). You can see how hydrophobic it is when you place coloured water drops on top. They simply sit on the surface like raindrops on leaves.

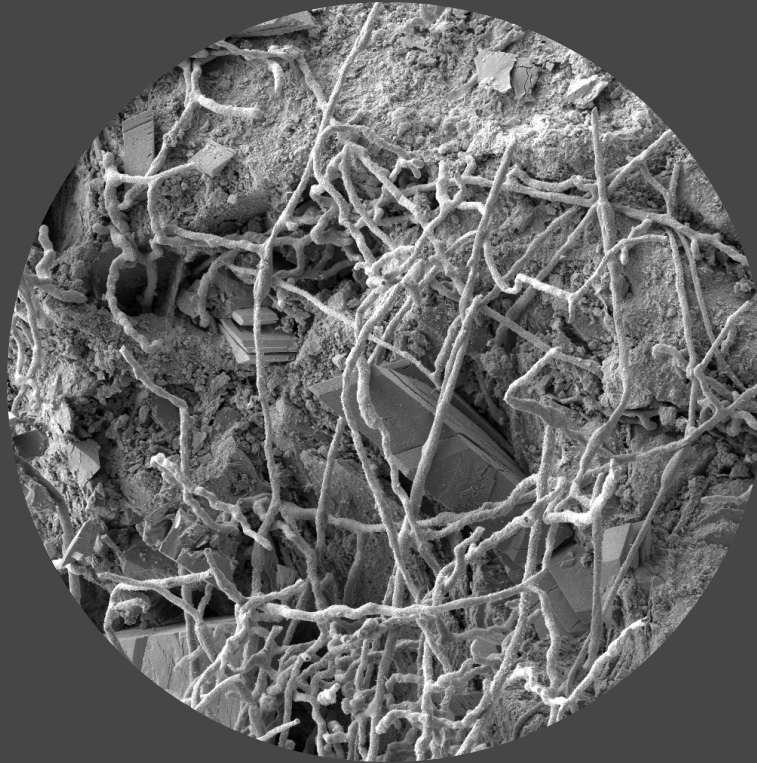


Image:
Xia Kang and Geoff Gadd
University of Dundee

FUNGUS AT WORK

- Fungus
- Magnification 400x

This is a fungus (*Aspergillus niger*) growing on monazite, a mineral that contains phosphorus and rare elements (lanthanum, cerium and neodymium) that are important in phones and computers. The fungus can extract these elements from the mineral which gives us an environmentally friendly way to recover them.



Image:
Sarah Coulthurst
University of Dundee

SEARCHING FOR FOOD

- Bacteria
- Magnification 2x

A bacterium called *Serratia marcescens* swimming in search of fresh nutrients (food). The bacteria started from the two white spots then swam outwards through the soft jelly as they used up the nutrients where they were.

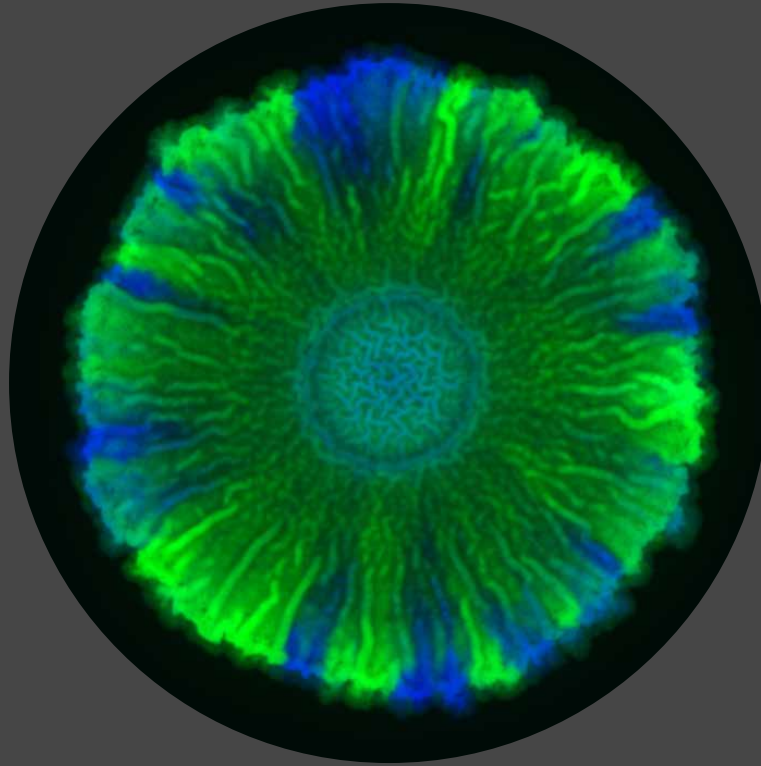


Image:
Thibault Rozazza
University of Dundee

BIOFILM BUILDING

- Bacteria
- Magnification 5x

One bacterium is labelled green and the other blue. Together they are building a biofilm. The green bacteria grow faster than the blue, so there are more green bacteria in this biofilm picture.

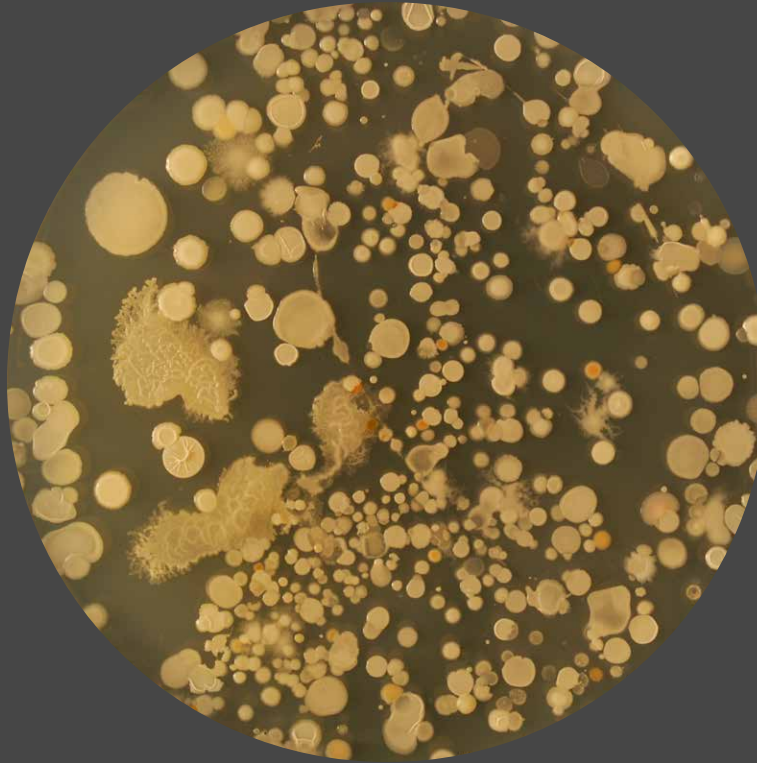
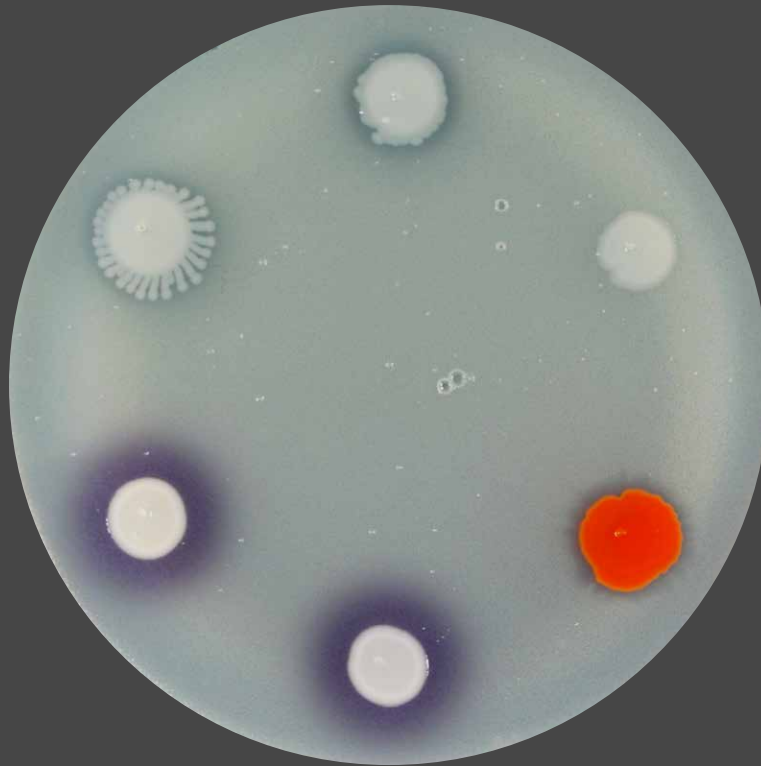


Image:
Margarita Kalamara
University of Dundee

SOIL MICROBES

- Mixed Sample
- Magnification 2x

There can be more microbes in a teaspoon of soil than there are people on Earth! They help plants to grow by making it easier for them to get important elements like nitrogen and phosphorus from the soil.



20



Image:
Sarah Coulthurst
University of Dundee

BACTERIAL REACTIONS

- Bacteria
- Magnification 2x

Bacteria can make many things, including coloured pigments and antibiotics. The bacteria covering the surface of this plate make a purple pigment in response to chemical signals from the bacteria in two of the white spots.



Image:
Margarita Kalamara
University of Dundee

MICROBE CARE

- Mixed Sample
- Magnification 2x

How well plants and crops grow in soil is closely linked with the microbes that live in it. The use of chemical fertilisers and pesticides changes the balance and health of the microbe community.



Image:
Erin Hardee
University of Dundee

SKIN MICROBES

- Mixed Sample
- No magnification

Microbes on our skin are part of our 'microbiome'. There are at least as many microbial cells in a human body as there are human cells. This includes microbes that live on the skin and inside us in places like our intestines and mouth.

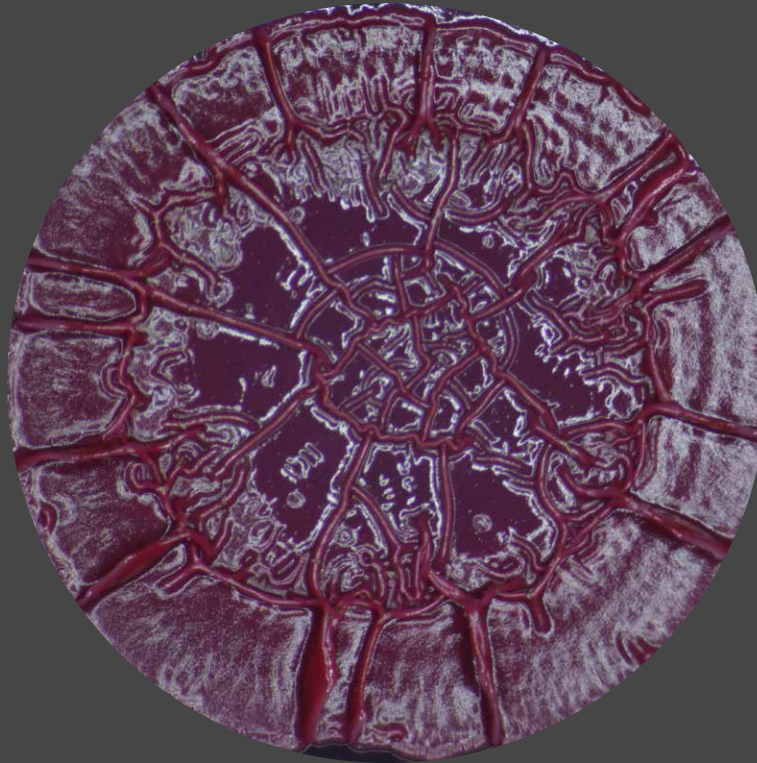


Image:
Nicola Stanley-Wall
University of Dundee

BACTERIAL COLONIES

- Mixed Sample
- No magnification

These are colonies of bacteria that have grown in groups. The single bacteria come in a variety of shapes and sizes depending on the species. Some are round, others are rod shaped or come in spirals.



24



Image:
Megan Bergkessel
University of Dundee

BACTERIAL STRUCTURES

- Bacteria
- Magnification 8x

Many bacteria form elaborate, wrinkly structures when they grow as large groups on a solid surface. There are billions of individual bacteria piled on top of each other in this image, and they are thought to form these structures to improve the access of the cells to fresh air.

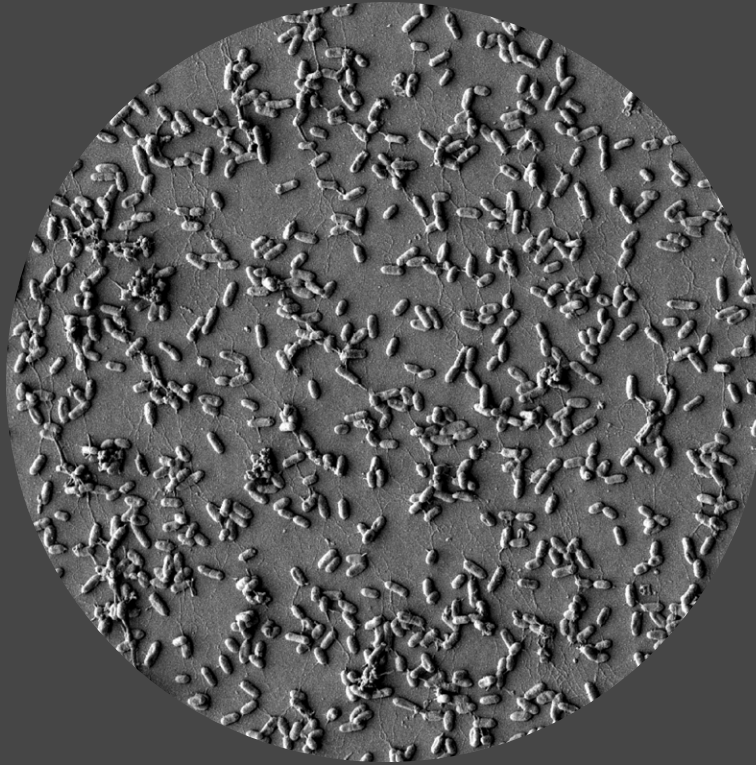


Image:
Chih-Yu Hsu
University of Dundee

FOOD POISONING

- Bacteria
- Magnification 20,000x

Listeria monocytogenes causes food poisoning. The bacteria can grow in cold and acidic environments. This is one of the reasons it is a successful pathogen (disease causing microbe). If you look closely in the image you might see flagella extending from the cells, which they use to move around.

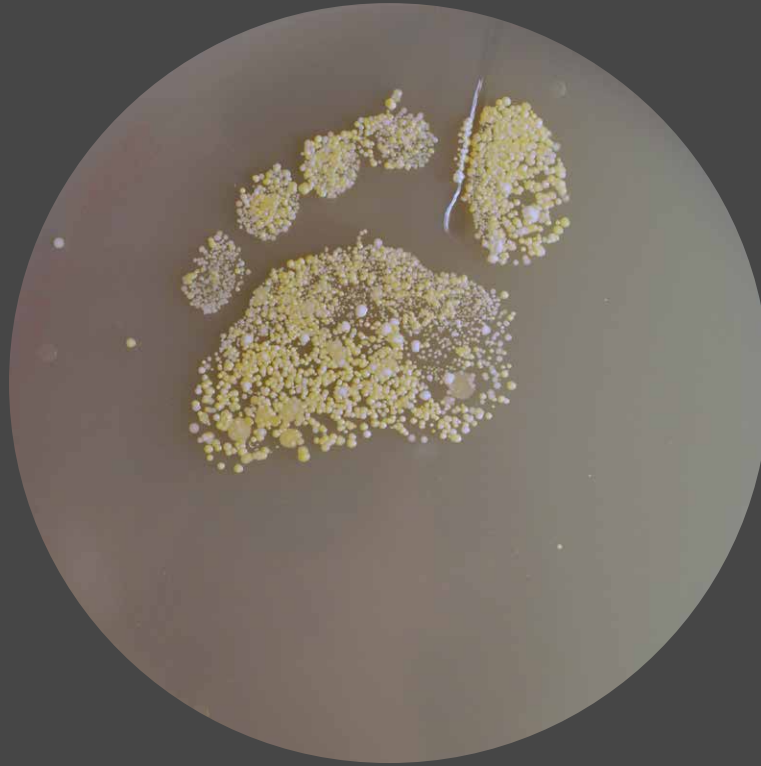


Image:
Nicola Stanley-Wall
University of Dundee

MICROBE CONDITIONS

- Mixed Sample
- No magnification

Different microbes live in different areas of the skin. Regions such as the armpit, belly button or between the toes are warmer and wetter so encourage the growth of microorganisms that like to live in moist conditions.



27



Image:
Erin Hardee
University of Dundee

MICROBE JOBS

- Mixed Sample
- No magnification

Microbes on our skin have lots of different jobs. Some eat dead skin cells while others feed on your sweat and make a strong smell. As each person has a different mixture of bacteria on their skin, everybody has a unique smell.



Image:
Nicola Stanley-Wall and Lewis Houghton
University of Dundee and lewspics.com

MICROBE HOMES

- Bacteria
- Magnification 2x

The microbes that make up our microbiome don't just live on our skin. They also live in our nose, mouth and intestines. The microbes on this agar plate used to live inside someone's nose!



Image:
Sarah Coulthurst and Louise Walker
Universities of Dundee and Aberdeen

PROTEIN SPEARGUNS

- Mixed Sample
- Magnification 30,000x

The big *Candida albicans* cell (fungus) is surrounded by smaller *Serratia marcescens* cells (bacteria). The bacteria attach to the fungus and try to kill it with a protein 'speargun' which fires toxins into other cells.

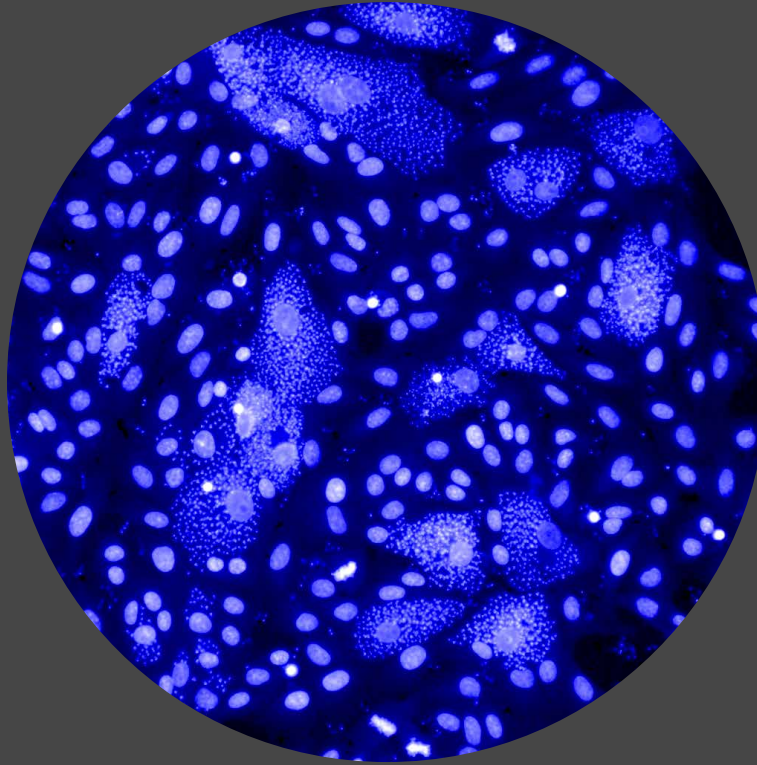


Image:
Manu De Rycker and John Thomas
University of Dundee

HIDING INSIDE

- Protozoa
- Magnification 1000x

Each small dot is a parasite called *Trypanosoma cruzi*, living inside a larger mammalian cell. Infection leads to Chagas disease, a major cause of heart damage in Latin America.

ABOUT THE SCIENTISTS

Megan Bergkessel is a UKRI (UK Research and Innovation) Future Fellow, and she researches how bacteria survive when they are starving for essential nutrients.

Sarah Coulthurst is a Wellcome Trust Senior Fellow and a Professor of Microbial Interactions. She is interested in how bacteria compete with and kill each other.

Manu De Rycker is the Head of Translational Parasitology at the Drug Discovery Unit. His research focuses on learning how parasites work and using that information to make new medicines.

Helge Dorfmueller is a Wellcome Henry Dale Fellow and studies how harmful bacteria that cause strep throat or scarlet fever produce a protective sugar shield.

Marina Fomina was a postdoctoral research assistant in Prof Geoff Gadd's laboratory.

Geoff Gadd holds the Boyd Baxter Chair of Biology and is interested in the roles of microorganisms as agents of geological and environmental change.

Erin Hardee is the School of Life Sciences' Schools Outreach Organiser who loves learning new things about the world of microbes.

Lewis Houghton is a professional photographer who can be found at lewspics.com

Chih-Yu Hsu obtained his PhD at the University of Dundee and is now a postdoctoral researcher focusing on how bacteria produce nano-scale particles named membrane vesicles.

Margarita Kalamara is a PhD student funded by BBSRC (Biotechnology and Biological Science Research Council) and is studying how bacteria of the same species compete when they are forced to live together.

Xia Kang was a PhD student in Prof Geoff Gadd's laboratory.

Saria Mansoor is a PhD student funded by the Medical Research Council and is interested in how bacteria protect themselves from the external environment.

Sujatha Manthri is a screening scientist within the Drug Discovery Unit. Her research includes work on making new medicines to treat Visceral Leishmaniasis.

Thibault Rozazza is a PhD Student funded by Wellcome and is interested in how bacteria interact and co-exist together.

Nicola Stanley-Wall is a Professor of Microbiology and is interested in how bacteria form social communities called biofilms. Nicola led the Images of Microbiology project.

Karen Stephenson was a PhD student in Prof Geoff Gadd's laboratory.

John Thomas is a biologist within the Drug Discovery Unit. His work has focused on new treatments for parasitic illnesses like Chagas' disease.

Louise Walker is a postdoctoral scientist based at the University of Aberdeen.



School of Life Sciences
University of Dundee



dundee.ac.uk

The work of the scientists featured in this booklet was funded by:



UK Research
and Innovation



National Biofilms
Innovation Centre



wellcome
centre
anti-infectives
research

The project was developed in partnership with:
Dundee Science Centre (DSC)

University of Dundee
Nethergate, Dundee, DD1 4HN
United Kingdom
+44 (0)1382 383000
contactus@dundee.ac.uk

We would love to hear from you.
Tweet us your thoughts, questions,
and photographs:

 @UoDLifeSciences